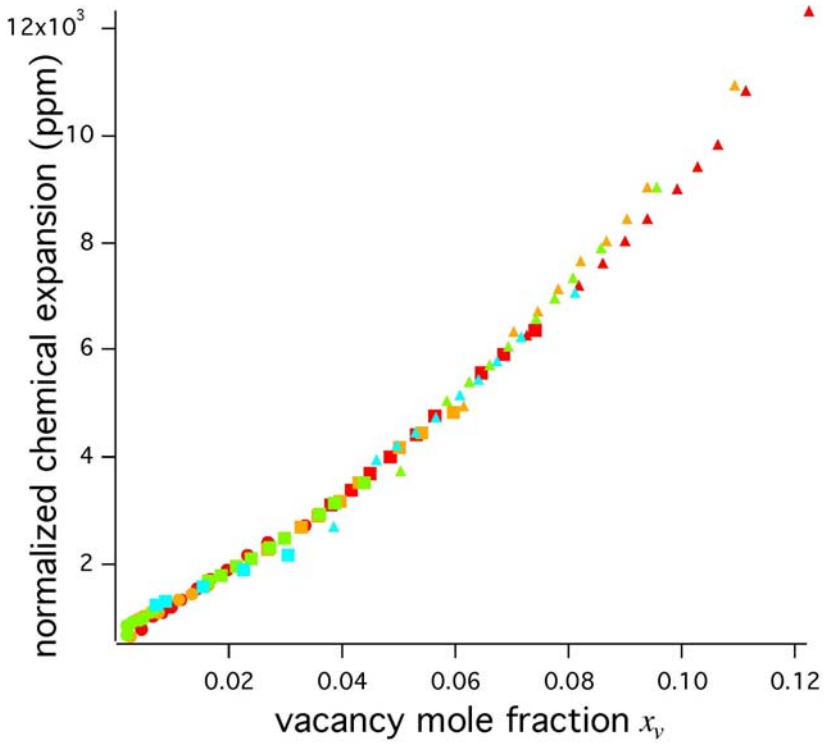
Chemical Expansion of Mixed-Conducting Ceramics

Stuart B, Adler, Univ. Washington, DMR-0222001

Almost all solid materials exhibit thermal expansion. However, mixed-conducting ceramics (oxides which conduct both electrons and ions) also expand upon changes in oxidation state (*chemical* expansion). Using a controlled atmosphere and temperature dilatometer, we have measured this effect for a variety of materials in the (La,Sr)(Co,Fe)O_3 family of perovskite materials. The instrument is currently being modified to allow transient measurements of oxygen exchange and diffusion rates in these materials, under conditions relevant to fuel cell electrodes.

S. B. Adler, "Chemical Expansivity of Electrochemical Ceramics", *J. Amer. Ceram. Soc.,* 84(9), 2117 (2001).



Normalized chemical expansion of $La_{1-x}Sr_xCoO_{3-\delta}$ as a function of Sr content (x), temperature (T), and oxygen vacancy mole fraction (x_v=δ/3). Symbols: x = 0.2 (circles), 0.4 (squares), 0.7 (triangles); Colors: T = 900°C (red), 800°C (orange), 700°C (green), and 600°C (blue). Note that by subtracting thermal expansion, data from different materials and temperatures have a similar dependence of chemical expansion on vacancy concentration.

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Education:

To date this project has involved one MS student (Jinsong Yu), one PhD student (Xiyong Chen) and one undergraduate (Ryan Reed). Jinsong, a student at Case Western Reserve University graduated with his MS and is now pursuing a PhD in Materials Science. Xiyong Chen is in his 3rd year. This project has produced 2 papers to date, with two in preparation. The results of this work have also directly benefited the PI's instructional education program, which includes a popular internet-based distance-learning course on Solid Oxide Fuel Cells. The results have also benefited the PI's DOE-sponsored research program on SOFC electrodes, which has direct ties to national lab and industrial fuel cell development.

Outreach:

PI Stuart Adler and his students participate actively in educational outreach. Dr. Adler was the organizer for the 2002 Chemical Engineering open house at UW, which hosted approximately 3000 Seattle-area elementary and high school students.

Lisa Fay-Lucas demonstrates properties of liquid nitrogen as she makes ice cream and tries to keep up with the demand.